Subject: Evaluation of Impacts of Use of Groundwater by the PEC on Mendota and Firebaugh Water Supplies

Issue: The June 2007 Preliminary Staff Assessment (PSA) for the Panoche Energy Center (PEC) states:

> The PEC's use of groundwater could increase the likelihood of subsidence to resume. Additionally, the City of Mendota and other nearby communities use well water from the lower aquifer for their domestic water supply after state mandated filtration and treatment. With the additional consumption of lower aquifer groundwater from the PEC, there could be a detrimental impact on lower aquifer groundwater supply. The additional pumpage of lower aquifer groundwater could increase the salinity level of the lower aquifer groundwater as well as the quantity of groundwater available. As the lower groundwater is considered fresh inland waters, the proposed usage of this source of groundwater would contribute to the diminishing drinking water supply, which would significantly impact the municipal well water supply of Mendota and other nearby communities. It has been stated by the City of Mendota engineer and documented in several reports that the lower aquifer groundwater is the area's last supply of good quality water. (CEC, 2007, p. 4.9-7)

Based on its assessment of the proposed PEC project, the CEC staff proposed Condition of Certification **Soil & Water-7:** Water used for the PEC shall not be lower aquifer groundwater, nor shall the water supply for the PEC significantly impact other water users.

Background

Figure 1 is a topographic map showing the locations of the PEC and the City of Mendota and other nearby communities. Figure 2 is a conceptual geologic cross section of the groundwater basin in the vicinity of the PEC and the City of Mendota. The location of this cross section is identified in Figure 1. Groundwater within the region is present within an upper, semi-confined aquifer and a lower, confined aquifer. As described in section 5.5.1.6.2 of the PEC AFC, these aquifers are separated by the Corcoran Clay aquitard. The Corcoran Clay (E-clay) is an extensive diatomaceous-lacustrine clay deposit of low permeability that retards groundwater movement between the two aquifers.

The semi-confined aquifer consists of alluvial deposits located above the Corcoran Clay. As described in section 5.5.1.6.3 of the PEC AFC, the primary mechanism of recharge of the semi-confined aquifer is percolation of applied irrigation water. The Coast Range located on the west side of the San Joaquin Valley consists of marine sediments containing high levels of dissolved minerals. Recharge of applied irrigation water on the west side of the Valley dissolves minerals from the marine sediments increasing total dissolved solids (TDS) concentrations in the semi-confined aquifer. TDS concentrations in the semi-confined aquifer generally decrease with increasing distance from the west side of the Valley. In the area of the PEC, the semi-confined aquifer is composed of alluvium of Coast Range provenance (Coast Range sediments) which results in low quality groundwater within the aquifer. In the area of Mendota, the semi-confined aquifer is composed of alluvium of Sierra Nevada provenance (Sierran sediments). While these deposits generally produce good quality water to the east of Mendota, water within these deposits can be recharged by infiltration of applied irrigation water from the west and be of low quality due to minerals dissolved from Coast Range sediments the groundwater flows through.

The confined aquifer consists of alluvial deposits located below the Corcoran Clay. The confined aquifer is recharged from the west by seepage from Coast Range streams along the west side of the subbasin and the deep percolation of surface irrigation and from the east by infiltration of runoff from the Sierras into permeable soils on the east side of the valley. Sierran runoff that is infiltrated has relatively low concentrations of total dissolved solids TDS. However, the TDS concentrations in the confined aquifer increases as the groundwater dissolves minerals in formations located in the west side of the Valley. In the area of the PEC, the confined aquifer is predominantly composed of Coast Range sediments with interbedded Sierran sediments in the upper part of the aquifer. In the area of Mendota, the confined aquifer is predominantly composed of Sierran sediments with interbedded deposits of Coast Range sediments. As in the overlying semi-confined aquifer, the presence of Coast Range sediments lowers groundwater quality due to soluble minerals within the deposits.

CEC staff appears to have confused use of the terms shallow or upper aquifer and deep or lower aquifer to describe aquifers in the area around Mendota. Locally, wells primarily completed in deposits above the A-clay (generally less than 130-feet deep) are termed "shallow." Wells completed in deposits below the A-clay but above the Corcoran Clay are termed "deep" (US Department of the Interior, 2002). In this case, both shallow and deep aquifers are semi-confined and are above the Corcoran Clay. The Cities of Mendota and Firebaugh use semi-confined aquifers for water supply and the PEC proposes to use confined aquifers for water supply.

The Use of Groundwater from the Confined Aquifer will not Significantly Contribute to Subsidence

In their review of the Geologic Hazards Section of the PEC AFC, CEC staff found that *although the applicant is proposing to pump groundwater, the affected aquifer is relatively deep and waste water will be disposed of using deep well injection. As a result, staff has determined that there is no significant potential for subsidence due to ground water withdrawal at the proposed PEC* (CEC, 2007). Ground subsidence due to groundwater withdrawal is a regional geologic hazard produced by extraction of large volumes of groundwater from many wells, not a localized one produced by withdrawal of groundwater at one location. Prior to the construction of major canals or aqueducts, irrigation in the region was almost wholly from thousands of large and deep irrigation wells, and conditions of groundwater overdraft prevailed since the 1930's. Extractions of groundwater in the San Joaquin Valley for irrigation increased from 3 million Acre-feet (AF) in 1942 to at least 10 million AF in 1966. Land subsidence due to groundwater overdraft began in the mid-1920's and continued at increasing rates until surface water replaced groundwater (Ireland, 1984).

As a result of importation of surface water to subsiding areas via canals and the California Aqueduct, pumping of groundwater in these areas was greatly reduced and the rapid decline of artesian head was reversed, starting in the late 1960's and early 1970's. By 1983, groundwater levels in most actively subsiding areas in the San Joaquin Valley groundwater basin had returned to or recovered above their 1940-50 levels and subsidence had slowed considerably or stopped. Because the deposits of the groundwater basin are now largely preconsolidated by past subsidence, the basin can be managed for cyclic groundwater storage nearly to this historic low water levels without serious additional land subsidence (Ireland, 1986).

During the 1990's, groundwater pumping increased within the region because of reduced surface water deliveries caused by drought and regulatory actions. Groundwater pumping within the Westlands Water District reached an estimated 600,000 AF annually during 1991 and 1992. A hydrograph for a well close to the PEC monitored by the DWR showing generally rising groundwater elevations and a decline associated with relatively increased groundwater withdrawal in the early 1990s is provided as Figure 3. As a result of the groundwater pumping, increased subsidence occurred in the District and other areas of the western Central Valley. The California Department of Water Resources (DWR) estimated the amount of subsidence since 1983 to almost 2 feet in some areas of the District with most of that subsidence occurring since 1989 (Westlands, 2006). The maximum annual groundwater demand by the PEC of 1,154 AF would be less than 0.2 percent of the annual Westlands Water District 1991 or 1992 groundwater demand and about 0.5 percent of the typical District groundwater demand of about 200,000 AF.

The PEC will not Access the Mendota and Firebaugh Water Supply Aquifer

Wells 07, 08, and 09 provide the City of Mendota's water supply (City of Mendota, 2006). These wells are completed above the Corcoran Clay (Luhdorff and Scalmanini, 2001; Steele, pers. comm. 2007) and are within the semi-confined aquifer (see Figure 2). The City of Mendota's wells are located in the Mendota Pool area, where most of the wells are completed above the Corcoran Clay and almost all of the water pumped in the area is from the semi-confined aquifer system (US Department of the Interior, 2002). Wells 7, 10, 11, 12, 13, 15 and 16 provide the City of Firebaugh's water supply and are completed to as deep as 335 feet below ground surface (City of Firebaugh, 2006, Chavarria, pers. comm. 2007). The wells are above the Corcoran Clay (Steele, pers. comm., 2007) and within the semi-confined aquifer. Conversely, the PEC proposes to use the confined aquifer with wells expected to be more than 1,000 feet deep. Therefore, the PEC will not access the aquifer providing water supply to the Cities of Mendota and Firebaugh.

The PEC will not Impact the Mendota and Firebaugh Water Supply Aquifer

In addition, as described above, the Corcoran clay retards mixing of and communication between the semi-confined and confined aquifers. Therefore, the use of the confined aquifer will not impact either the volume or quality of the semi-confined aquifer that provides water supply to the cities. Tables 1 and 2 show groundwater quality data for samples collected from groundwater monitoring wells within the semi-confined and confined aquifers at the PEC in comparison to groundwater quality data for the Cities of Mendota and Firebaugh. Parameters such as TDS and detected levels of other constituents are typically higher at the PEC than nearby communities for groundwater even before treatment, indicating that lower quality groundwater underlies the PEC and that the groundwater bodies are distinct.

Extractions by the PEC will not Degrade Water Quality in the Confined Aquifer

The PEC is located on the west side of the Westside Subbasin and will extract groundwater with relatively elevated TDS concentrations. To the extent that the TDS is removed from the confined aquifer and disposed of in deep formations via the proposed injection wells, water quality in the confined aquifer will be improved. Primary recharge in the Westside Subbasin is from the seepage of Coast Range steams along the west side of the subbasin and the deep percolation of surface irrigation. Secondary recharge to the aquifers occurs from areas to the east and northeast as subsurface flows (DWR, 2006). Recharge from Coast Range streams and surface irrigation typically produces low quality groundwater while subsurface flows from the east and northeast are typically good quality groundwater. The PEC is located on the western side of the Westside Subbasin; any groundwater pumped from the confined aquifer would reduce the influence of relatively low quality Coast Range streams and surface irrigation recharge to the northeast of the PEC.

The Confined Aquifer is not an Economic Water Supply Alternative for the Cities of Mendota and Firebaugh

Use of groundwater within the confined aquifers underlying the City of Mendota and surrounding communities as a domestic water supply would require the installation of deeper, more expensive wells than are currently in use, increased pumping costs, and likely increased water treatment costs. Use of confined aquifer groundwater appears to be an uneconomic choice for the communities.

Conclusion

The use of the confined aquifer for water supply by the PEC will not result in significant impacts. Regional groundwater levels have been rising since surface water deliveries began with the exception of temporary declines during drought periods. The PEC will neither access nor impact the quantity or quality of groundwater in aquifers used for municipal supply by the Cities of Mendota and Firebaugh. In addition, by removal of TDS, the PEC will incrementally contribute to the improvement of the quality of groundwater in the confined aquifer. Finally, the use of the confined aquifer will not significantly affect the availability of future municipal water supplies as more economical water supplies are available to the surrounding communities.

References

California Department of Water Resources, 2006. California Groundwater Bulletin 118, Tulare Lake Hydrologic Region, San Joaquin Valley Groundwater Basin, Westside Subbasin.

California Energy Commission, 2007. Preliminary Staff Assessment, Panoche Energy Center, Application for Certification (06-AFC-5), Fresno County. June, 2007.

Chavarria, T., 2007. Personal Communication with Tony Chavarria, City of Firebaugh Utilities Supervisor. July 19, 2007.

City of Firebaugh, 2006. 2006 Consumer Confidence Report.

City of Mendota, 2006. 2006 Consumer Confidence Report.

Ireland, R.L., 1984. Land Subsidence in the San Joaquin Valley, California as of 1980. US Geological Survey Professional Paper 437-I.

Ireland, R.L., 1986. Land Subsidence in the San Joaquin Valley, California, as of 1983. US Geological Survey Water-Resources Investigations Report 85-4196.

Luhdorff and Scalmanini and Kenneth D. Schmidt and Associates, 2001. Mendota Pool Group Pumping and Monitoring Program: 2000 Annual Report. December 2001.

Steele, A.W., 2007. Personal Communication with Al Steele, Engineering Geologist with California Department of Water Resources, San Joaquin District. June 29, 2007 and July 19, 2007

US Department of the Interior, 2002. Draft Environmental Assessment, EA Number 01-83, Mendota Pool 2002 Exchange Agreements. January, 2002.

Westlands Water District, 2006. Deep Groundwater Conditions Report. March, 2006.